

### Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application, where added material is shown in underlined type, deleted material is shown in ~~strikeout type~~:

### **Listing of Claims:**

1. (Currently amended) A method for controlling a switch comprising:  
a number of input ports, each receiving data cells on a respective link;  
a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue;  
a flow control means for pausing and un-pausing senders on selected links; the method including the steps of:  
monitoring the remaining available buffer space AS of the shared buffer;  
estimating the expected total content LE of the links;  
calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links  $FM=AS-LE$ ;  
if the free margin sinks below a threshold  $AS-LE < A$ , then a selected link is paused; and  
if the free margin thereafter raises above a threshold  $AS-LE > B$ , then a selected paused link is un-paused.
2. (Original) A method according to claim 1, wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link.
3. (Original) A method according to claim 2, wherein the content LE of the links is estimated as the sum of the contents of all the input links.
4. (Original) A method according to claim 3, wherein the estimation of the content LE of the links takes into account the different link lengths and bit rates.

5. (Original) A method according to claim 4, wherein each link estimate is based on a model of the behaviour of each port.
6. (Original) A method according to claim 5, wherein the model consists of a curve having different segments, each segment reflecting a specific state of the port.
7. (Original) A method according to claim 6, wherein the states include:
  - a state in which the link is full and contains a maximum amount of data;
  - a state in which the port is to be paused and is waiting for a pause frame to be sent and in which the link remains at the maximum amount for a fixed duration or until the pause frame is sent;
  - a state in which a pause frame is sent and the port is waiting for a fixed duration to allow a packet to leave the sender, and in which the link remains at the maximum amount;
  - a state in which the pause frame has reached the sender and the link content is decreased linearly with time to a minimum amount;
  - a state in which the port is to be un-paused and is waiting for an un-pause frame to be sent and in which the link remains constant for a fixed duration; and
  - a state in which an un-pause frame is sent and the link content is increased linearly with time to the maximum amount.
8. (Original) A method according to claim 7, wherein the maximum amount of data equals twice as much as a round trip content plus two full-sized packets.
9. (Original) A method according to claim 7, wherein the minimum amount of data equals one full-sized packet.
10. (Original) A method according to claim 7, wherein the slopes of the linear increase and decrease depend on the bit rate of the respective link.
11. (Original) A method according to claim 2, wherein the most offending sender is paused first.

12. (Original) A method according to claim 2, wherein the least offending sender is un-paused first.
13. (Original) A method according to claim 11 or 12, wherein offending senders are detected by means of an overflow sum counter OFS.
14. (Original) A method according to claim 13, wherein a counter OFS is associated with each input port, and is increased each time the input port sends a packet to a congested output port.
15. (Original) A method according to claim 14, wherein the counter OFS of each input port is increased with the packet length, each time the input port sends a packet to a congested output port.
16. (Original) A method according to claim 14, wherein the counter OFS is reset to zero when its associated input port receives an un-pause frame
17. (Original) A method according to claim 14, wherein an output port is considered congested if the queue length thereof exceeds a threshold.
18. (Currently amended) A method ~~according to claim 17~~, for controlling a switch comprising:  
a number of input ports, each receiving data cells on a respective link; a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue; a flow control means for pausing and un-pausing senders on selected links; the method including the steps of:  
monitoring the remaining available buffer space AS of the shared buffer;  
estimating the expected total content LE of the links;  
calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links  $FM=AS-LE$ ;  
if the free margin sinks below a threshold  $AS-LE < A$ , then a selected link is paused;

if the free margin thereafter raises above a threshold  $AS-LE > B$ , then a selected paused link is un-paused;

wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link;

wherein the most offending sender is paused first or wherein the least offending sender is un-paused first;

wherein offending senders are detected by means of an overflow sum counter OFS;

wherein a counter OFS is associated with each input port, and is increased each time the input port sends a packet to a congested output port; and

wherein an output port is considered congested if the queue length thereof exceeds a threshold; and

wherein the queue length threshold equals a maximum length packet.

19. (Currently amended) A method ~~according to claim 13~~, for controlling a switch comprising: a number of input ports, each receiving data cells on a respective link; a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue; a flow control means for pausing and un-pausing senders on selected links; the method including the steps of:

monitoring the remaining available buffer space AS of the shared buffer;

estimating the expected total content LE of the links;

calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links  $FM=AS-LE$ ;

if the free margin sinks below a threshold  $AS-LE < A$ , then a selected link is paused;

if the free margin thereafter raises above a threshold  $AS-LE > B$ , then a selected paused link is un-paused;

wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link;

wherein the most offending sender is paused first or wherein the least offending sender is un-paused first;

wherein offending senders are detected by means of an overflow sum counter OFS; and  
wherein a maximum value is defined for the OFS counters, and when one counter reaches  
this maximum, all counters are divided by 2.

20. (Currently amended) A method ~~according to claim 13,~~ for controlling a switch comprising:  
a number of input ports, each receiving data cells on a respective link; a number of output ports  
sharing a buffer space in which each output port can reserve space for an output queue, wherein  
incoming data cells are switched to an appropriate output queue; a flow control means for pausing  
and un-pausing senders on selected links; the method including the steps of:

monitoring the remaining available buffer space AS of the shared buffer;  
estimating the expected total content LE of the links;  
calculating a free margin (FM) as the remaining available buffer space minus the expected  
total content of the links  $FM=AS-LE$ ;

if the free margin sinks below a threshold  $AS-LE < A$ , then a selected link is paused;  
if the free margin thereafter raises above a threshold  $AS-LE > B$ , then a selected paused link  
is un-paused;

if the free margin thereafter raises above a threshold  $AS-LE > B$ , then a selected paused link  
is un-paused;

wherein the flow control means comprises a pause frame generator for generating pause  
frames to be sent to data senders in order to pause senders on a selected link, and generating un-  
pause frames to be sent to data senders in order to un-pause senders on a selected paused link;

wherein the most offending sender is paused first or wherein the least offending sender is  
un-paused first;

wherein offending senders are detected by means of an overflow sum counter OFS; and  
wherein a maximum value is defined for the OFS counters, and when one counter reaches  
this maximum, the value of the smallest counter is subtracted from all the counters.

21. (Original) A method according to claim 13, wherein all the OFS counters are  
decreased linearly with time.

22. (Original) A method according to claim 1, wherein the threshold A is set to zero ( $A = 0$ ).

23. (Original) A method according to claim 1, wherein the threshold A is set to a negative value ( $A < 0$ ).
24. (Original) A method according to claim 1, wherein the threshold A is less than or equal to the threshold B ( $A \sim B$ ).
25. (Original) A switch comprising:  
a number of input ports, each receiving data cells on a respective link;  
a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue;  
a flow control means for pausing and un-pausing senders on selected links; the switch further including means for:  
monitoring the remaining available buffer space AS of the shared buffer;  
estimating the expected total content LE of the links;  
calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links  $FM = AS - LE$ ;  
wherein the flow control means is arranged to pause a selected link, if the free margin sinks below a threshold  $AS - LE < A$ ; and to un-pause a selected paused link, if the free margin thereafter raises above a threshold  $AS - LE > B$ .
26. (Original) A switch according to claim 25, wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link.
27. (Original) A switch according to claim 26, wherein the content LE of the links is estimated as the sum of the contents of all the input links.

28. (Original) A switch according to claim 27, wherein the estimation of the content LE of the links takes into account the different link lengths and bit rates.
29. (Original) A switch according to claim 28, wherein each link estimate is based on a model of the behaviour of each port.
30. (Original) A switch according to claim 29, wherein the model consists of a curve having different segments, each segment reflecting a specific state of the port.
31. (Original) A switch according to claim 30, wherein the states include:
- a state in which the link is full and contains a maximum amount of data;
  - a state in which the port is to be paused and is waiting for a pause frame to be sent and in which the link remains at the maximum amount for a fixed duration or until the pause frame is sent;
  - a state in which a pause frame is sent and the port is waiting for a fixed duration to allow a packet to leave the sender, and in which the link remains at the maximum amount;
  - a state in which the pause frame has reached the sender and the link content is decreased linearly with time to a minimum amount;
  - a state in which the port is to be un-paused and is waiting for an un-pause frame to be sent and in which the link remains constant for a fixed duration; and
  - a state in which an un-pause frame is sent and the link content is increased linearly with time to the maximum amount.
32. A switch according to claim 31, wherein the maximum amount of data equals twice as much as a round trip content plus two full-sized packets.
33. (Original) A switch according to claim 31, wherein the minimum amount of data equals one full-sized packet.
34. (Original) A switch according to claim 31, wherein the slopes of the linear increase and decrease depend on the bit rate of the respective link.

35. (Original) A switch according to claim 26, wherein the flow control means is arranged to pause the most offending sender first.
36. (Original) A switch according to claim 26, wherein the flow control means is arranged to un-pause the least offending sender first.
37. (Original) A switch according to claim 35 or 36, wherein the flow control means contain an overflow sum counter OFS to detect offending senders.
38. (Original) A switch according to claim 37, wherein a counter OFS is associated with each input port, and is increased each time the input port sends a packet to a congested output port.
39. (Original) A switch according to claim 38, wherein the counter OFS of each input port is increased with the packet length, each time the input port sends a packet to a congested output port.
40. (Original) A switch according to claim 38, wherein the counter OFS is reset to zero when its associated input port receives an un-pause frame
41. (Original) A switch according to claim 38, wherein an output port is considered congested if the queue length thereof exceeds a threshold.
42. (Currently Amended) A switch ~~according to claim 41~~, comprising:  
a number of input ports, each receiving data cells on a respective link;  
a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue;  
a flow control means for pausing and un-pausing senders on selected links; the switch further including means for:  
monitoring the remaining available buffer space AS of the shared buffer;  
estimating the expected total content LE of the links;



calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links  $FM=AS-LE$ ;

wherein the flow control means is arranged to pause a selected link, if the free margin sinks below a threshold  $AS-LE < A$ ; and to un-pause a selected paused link, if the free margin thereafter raises above a threshold  $AS-LE > B$ ;

wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link;

wherein the flow control means is arranged to pause the most offending sender first; Or  
wherein the flow control means is arranged to un-pause the least offending sender first;

wherein the flow control means contain an overflow sum counter OFS to detect offending senders;

wherein a counter OFS is associated with each input port, and is increased each time the input port sends a packet to a congested output port;

wherein an output port is considered congested if the queue length thereof exceeds a threshold; and

wherein the queue length threshold equals a maximum length packet.

43. (Currently Amended) A switch ~~according to claim 37~~, comprising:

a number of input ports, each receiving data cells on a respective link;

a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue;

a flow control means for pausing and un-pausing senders on selected links; the switch further including means for:

monitoring the remaining available buffer space AS of the shared buffer;

estimating the expected total content LE of the links;

calculating a free margin (FM) as the remaining available buffer space

minus the expected total content of the links  $FM=AS-LE$ ;

wherein the flow control means is arranged to pause a selected link, if the free margin sinks below a threshold  $AS-LE < A$ ; and to un-pause a selected paused link, if the free margin thereafter raises above a threshold  $AS-LE > B$ ;

wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link;

wherein the flow control means is arranged to pause the most offending sender first; Or  
wherein the flow control means is arranged to un-pause the least offending sender first;

wherein the flow control means contain an overflow sum counter OFS to detect offending senders; and

wherein a maximum value is defined for the OFS counters, and when one counter reaches this maximum, all counters are divided by 2.

44. (Currently Amended) A switch ~~according to claim 37~~, comprising:

a number of input ports, each receiving data cells on a respective link;

a number of output ports sharing a buffer space in which each output port can reserve space for an output queue, wherein incoming data cells are switched to an appropriate output queue;

a flow control means for pausing and un-pausing senders on selected links; the switch further including means for:

monitoring the remaining available buffer space AS of the shared buffer;

estimating the expected total content LE of the links;

calculating a free margin (FM) as the remaining available buffer space minus the expected total content of the links  $FM=AS-LE$ ;

wherein the flow control means is arranged to pause a selected link, if the free margin sinks below a threshold  $AS-LE < A$ ; and to un-pause a selected paused link, if the free margin thereafter raises above a threshold  $AS-LE > B$ ;

wherein the flow control means comprises a pause frame generator for generating pause frames to be sent to data senders in order to pause senders on a selected link, and generating un-pause frames to be sent to data senders in order to un-pause senders on a selected paused link;

wherein the flow control means is arranged to pause the most offending sender first; OR  
wherein the flow control means is arranged to un-pause the least offending sender first;  
wherein the flow control means contain an overflow sum counter OFS to detect offending  
senders; and  
wherein a maximum value is defined for the OFS counters, and when one counter reaches  
this maximum, the value of the smallest counter is subtracted from all the counters.

45. (Original) A switch according to claim 37, wherein all the OFS counters are decreased  
linearly with time.

46. (Original) A switch according to claim 25, wherein the threshold A is set to zero ( $A = 0$ ).

47. (Original) A switch according to claim 25, wherein the threshold A is set to a negative  
value ( $A < 0$ ).

48. (Original) A switch according to claim 25, wherein the threshold A is less than or equal to  
the threshold B ( $A \leq B$ ).